Questions about SEARS

June 30, 2003

What is the nominal expected mounting surface temperature for a box experiment?
-15C to +55C

I see in the SEARS the operational temperature range is -15 & 55 C, I assume this includes worse case factors. Do you have a feeling for what the range will likely be under "typical" conditions for one of the card experiments?

The -15°C could very well be a cold turn on temperature, since I will cold bias the design and that is the operational set point for the heaters. The +55°C is also possible if the all the experiments are powered "ON" and we are launched into a Beta angle of 45 degrees. If an experiment has an issue with the upper or lower temperature, we may be able to tailor the design and/or place them in a most favorable location.

What is the range of solar angles we can expect for the DMSP18 orbit?
0 to 90 degrees
Note: The Solar Orbit Angle (SOA) will most likely fall between 0 and 50° for DMSP-18.
Beta Angle = 90°-SOA

Do we know what orbit DMSP will be in (dawn/dusk?, day/nite?, ascending node?)
Updated November 5, 2003
Orbit: approximately 833 km, 98.7° inclination sun-synchronous. The Solar Orbit Angle (SOA) will most likely fall between 0 and 50° for DMSP-18. Beta Angle = 90°-SOA

Will DMSP18 experience eclipse during its orbit? Does this amount of eclipse time change over the course of the mission?
We will have eclipse, but if we launch into the 6am - 6pm orbit it will be negligible.

We are concerned about outgassing and contamination on our samples. We would like to be mounted such that the samples do not have a line-of-sight to the solar panel. Is this possible? Also, what is the location of vents with respect to our samples?
It will be difficult to impossible not to have a view of the solar panel. We can control the contamination vent path, but not your view to the solar panel.

July 3, 2003

Section 2 paragraph 1:Synchronous or asynchronous serial data?
Asynchronous, refer to Section 6.2 of SEARS

If the experiment is a double height card (6U) will SET provide two connectors?
YES

Section 6.1.3 (p. 24): Are the voltage monitors automatically sampled or only upon request?
Automatically sampled

How is the sampling rate of the voltage monitors specified?
No faster then once per second

How is the information retrieved by the experiment for inclusion with its telemetry to the ground?
Data frame as defined by the format

Section 5.3.1 (p. 17): The LPD requires 7W of regulated power, which exceeds the 4W indicated in this section. Is it possible for the LPD to exceed this specification?
LPD is considered a box experiment and therefore Section 5.3.2 is applicable, which allows up to 10 Watts.

Section 6.2.2 (p. 27) The Data Link Layer discussion references ISO/IEC 13239. Please provide a copy of this specification

I received an email stating that you were requesting access to ISO/IEC 13239. I have been researching this and I have been told it is as easy as you going to the website http://standards.nasa.gov/default.htm and downloading it. You will have to register/login in the Public Access link. This document is copyrighted so you will have to agree to the license rules. If this does not work for you, please let me know.

Section 6.2.2 (p. 27): Please confirm that for the carrier to receive telemetry from an experiment once every second, the carrier must send a command to the experiment every second to request such data and the experiment must incorporate the telemetry in the information section of its response packet.
Yes.

Section 6.2.2.1 (p. 28): Please clarify the maximum bit rate of the serial command and telemetry interface. Paragraph 3 of this section first states that the interface operates up to 128 KBaud, and then states that experiments shall be capable of operating up to a maximum of 64 KBaud. Is it possible for an experiment to operate at 128 KBaud?
No, maximum is 64 KBaud

Section 6.2.2.1 (p. 28) The specification states that the baud rate is programmable, and Section 7.2.2 (pp. 33-34) cites a carrier command to change the baud rate for a specific experiment. Can an experiment specify its default baud rate?
No

Or is the nominal rate of 48.02 KBaud imposed by the carrier at power-up?
48.02 is the default rate

Section 6.2.2.1.1 - What baud rate are you picking?
Experiment picks with 19.2k being minimum and 64K Baud the maximum.

Section 6.2.2.2.3 - What type of jumpers?
1 Ohm resistor or bus wire.
Who decides the address?
SET does.
When is it decided?
Unpopulated upon delivery.

Section 6.2.2.2.3 (p. 29) The inclusion of an Address Field in the HDLC frame format suggests that every experiment can see all the commands to all the different experiments, implying that the RS-422 link from the carrier to the experiments is shared. Figure 6-5 (Section 6.2.1.1 on page 25) suggests that each experiment has a dedicated set of RS-422 receive and transmit lines to the carrier. How is the RS-422 bus structured?
Refer to slide 55 in K/O presentation

Section 6.2.2.2.3 (p. 29) Will the LPD, operating as a CEM, be considered an experiment and have an address as well?
Yes, LPD would be considered an experiment.

Is either the upstream channel (Experiments to Carrier) or downstream channel (Carrier to Experiments) shared?
No.

Section 6.2.2.2.4 - Are test patterns define?
No experiment defined.

Section 7.2.5.1 (p. 35): Is it possible to specify that a power cycle be used in place of a reset capability?
Yes.

Explain commanding referred to in section B.8.2 (EARD), how will it work/be implemented?
Refer to Section 7.2 in SEARS. Also, refer to K/O presentation slides 47-62.

When will Appendix C become available? It is expected to include format and requirements for the T&C Handbook (Section 7.2), directions for utilizing Carrier command (Section 7.2.2), and directions for utilizing Event commands (Section 7.2.3).
TBD

Section 7.11 Will time be sent to the experiments?
Not to experiment hardware. Telemetry will be timestamped and available for post processing to correlate with GMT.

Section 9.2 - Will support data be time tagged? Is time tagged data relative to transfer or to data acquisition? (If to data transfer, are things methodical enough to work backwards and get acquisition time?)
All telemetry packets will be time-tagged. They will have what we in the FSW group call the "Carrier Elapsed Time" in the secondary header. The time on this header should be equal to the time that the packet is made which should be the time it is sampled via the RS-422.

Section 10.1.1 - Is this required for SETPath experiments? If so, do TSS or SINDA provide proper format? Yes and yes.

Section 10.5.1.1.1 - How much of the experiment weight limit is consumed by the 4 oz. requirement? How much is consumed by the required components?
Connector and parts.

Section 11.1.3 Table 11-3 Can we get a graph of this?
http://essp.gsfc.nasa.gov/essplib/pdf/gevs.pdf - page 75 has the chart graphically.

Section 1.3 EMI/EMC Is this test required for SETPath experiments or are you going to do it as a system?
This test is not required (always nice to do beforehand, though), but an analysis should be performed to show that proper EMI/EMC precautions have been implemented. A payload level EMI/EMC test will be performed, and if an experiment is in violation of emission/compatibility, then there is a chance of experiment removal.

Section 11.4 Need graph of temp cycling.
4 cycles, starting with hot transition... 4 hour soak and functional test following at each soak. End with +35C prior to backfill.

Section 12 Is I&T plan required for SETPath? Not planned or costed.
It would be very helpful for experimenters to develop a short I&T plan, including schedule, configurations, test procedure development, interface testing with carrier, test levels during environmental testing, analysis etc., for planning purposes. It will ultimately save time and money

when you do this up front. Doesn't have to be a lengthy or detailed document, just capture basic I&T plans.

Section 12.5 Only 2 weeks?
2 weeks was the basic idea, longer loans may be supported depending on number or simulators available and when they were requested. We are not planning on making a simulator for each experiment. We are planning on providing a software executable on a CD with a RS-422 card (either PCI or PCMCIA interface). The card will be on loan for up to 4 weeks at a time depending on requests from other experiments. If no other experiment requires the use of the hardware, it may be kept longer.

Section 12.6 Is being on-site required?
During certain times of I & T, payload representation will be required. Experiments are required to support the first time mechanical/electrical integration of their experiment with the carrier, and during payload thermal vacuum tests when mission simulations are rehearsed. The experiment is required to review all science data posttest in a timely fashion, to validate that no EMI susceptibility or thermal dependencies were experienced during payload level environmental testing.

June 30, 2003, Updated November 4, 2003
How should we submit the information required for Appendix B (EARDS) of the SEARS document?
Please email the document to carolyn.e.mariano@nasa.gov. The front page should be signed and faxed to John Kazeva in the Configuration Management (CM) at 301-286-1694. The signed document can also be mailed to:
Carolyn Mariano, NASA/GSFC Code 546, Greenbelt, MD 20771

July 25, 2003
What PCB thickness is assumed for the experiment boards - 0.062"? I'm not sure what thicknesses the backplane connector can support.
Minimum thickness - A minimum thickness of .062" is recommended for structural integrity. However, the board will have to be modeled and also pass vibration testing to guarantee this.

Maximum thickness - The connector leads are .109" in length. GSFC-NASA recommends .020" minimum of lead extension out of the opposite side of the PCB. So that equates to a maximum board thickness of .089". Connectors with longer leads may be required as needed for thicker boards.

Board Mounting - The board mounting surface is on the same side as the connector. So changes in board thickness do not move the connector position with respect to the backplane connector.

SEARS 6.2.2.2.2 - Iits not clear to me how a single flag can be used for both a start and stop delimiter unless the receiver expects this a-priori. Is there something in the command field that would indicate multiple frames linked in this way? Can an experiment op-out of this? (in a hardware implementation this would add complication the state machine design)
This may not be as complicated as you think. Here are a couple of thoughts that may clarify this.

As an example, in our state machine for the receive section, at the reception of a frame flag, the state machine is set to the start state. The next byte expected is the Address field. If we receive another frame flag, we just loop back to the same start state. We have a timeout condition that resets the state machine if no more bytes/frames are received. After power up or a reset(manual or timeout), the state machine defaults to a reset state where the first frame will require a frame flag at the start.

Specific to the next higher layer protocol, Layer 2, Section 6.2.3.2 specifies that only one

command will be sent per frame and that each command requires a response. So the Carrier will not be sending the experiment any multi-frame commands. However, the Carrier is capable of receiving them from experiments.

Also, as the experimenter, you define all of the commands and responses. So even if we did allow multi-frame commands, you still have the choice of not implementing any.

Finally, if you would like to customize this protocol, you can use the Experiment Defined Class, 6.2.2.4, that allows you to use the built in features of the HDLC classes or just have fixed length commands and responses. You would have to specify the details and work within the capabilities of the interface, but the intent is to implement the simplest interface required by the experiment.

SEARS 6.2.2.1 - How are the baud rates set? Is this commanded via the interface, externally jumpered, distributed baud clock ...? If commanded, will GSFC be providing the encoding for these commands? What speeds are required to be supported beyond the 48K, 64K, and 128K, mentioned?

For the experimenter, the baud rate will not change during operation. We do specify that the 48K in the nominal with a maximum 64K. However, lower rates such as 19.2K can be accommodated on a negotiated basis. We do not specify how to set this. Having a fixed rate or a programmable rate set with jumper settings are possible implementations. The choice is yours.

On the carrier side, the 128K is just specified for information purposed only to indicate the Carriers maximum capability. It is also capable of rates much slower than the 48K nominal.

If you would like to operate at one fixed rate that is not configurable, faster or slower than the nominal or maximum, you may request a waiver from the project. If you do this, I suggest sticking to a standard frequency that can be simulated with a PC serial interface.

Under what circumstance is STANDBY mode used? Slide 59 of Kickoff #2 implies experiment is put in STANDBY after every 40mS communications window. The implication seems to be an experiment must draw <100mW except during its comm. window or power will be removed completely between comm. windows - correct?
Not Correct. Section 7.1 of the SEARS document indicates that communication is limited to the 40ms window but that power is applied at 100% duty cycle. Typically, an experiment will be commanded to standby mode or normal mode during the 40mS communication window and will remain in the last mode commanded at the end of the window until commanded again in a following communications window.

Standby mode is mainly for two purposes. First, to share power resources among experiments while allowing them to maintain biases on DUTs or volatile memory and second, it may be used as a safety mechanism to minimize experiment power draw during anomalous conditions.
Slide 59 was just an example of an experimenter needing normal mode power to communicate, and only needing bias power other times. When I wrote the example, I was thinking of a simple RADFET experiment that needed a small bias current on the RADFET, that could then power up to normal mode to take a measurement and send out the value as telemetry, and then go back to just the bias condition again.

Is tri-state control required on the RS-422 transmitter? The wiring diagram implies point-to-point connection between experiments and carriers. If point-to-point, is there anytime the TX should be tri-stated ... e.g. STANDBY?
Tri-state control in not required. RS-422 is a point to point or multi-drop(one to many) specification that only allows one driver(generator) per line. RS-485 is the similar specification that uses the same drivers and receivers as 422, but allows for multipoint (multi driver, tri-state capable) connections. We specify RS-422 only.

As an added note, there have been several questions about the address field requirements in the HDLC formats. Part of the reason for using the address field is to maintain compatibility with the HDLC specification and additionally to allow for the possibility of automated command and telemetry routing to different paths of the communications channel. As stated before, the experimenter can modify the HDLC standards using the Experimenter Defined Class for the Layer 1 protocol. You could either not have an address field or have a dummy value in this byte. It cannot however be used as an extra telemetry byte over the 128byte maximum.

The 4 output signals are TEMP P&N (pins 18-19), DOS P&N (pins 45-46), and ANA1 P&N (pins 72-73) and ANA2 P&N (pins 20 and 47). TLM N422A/P422A (pins 41-42) and TLM N422B/P422B (pins 67-68) are DIGITAL INPUT signals in differential mode. Is this interpretation correct?
Half Correct. Section 6.1 Describes the Analog telemetry of Temperature, Dosimeter, Analog 1 and Analog 2. Section 6.2 describes Command and Telemetry interfaces. Note, the pin-out contains an "A", primary, and "B" , redundant 422 differential interface pair of both Command and Telemetry. The "B", redundant pair is not implemented and is in the pin-out for future use. Also note, TLM is an OUTPUT from the Experiment. CMD is an INPUT to the experiment.

What is TLM (digital, pin 53) intended to be used for?
See section 6.2.1.3.

Assuming the Telemetry TLM pins are input pins, as experimenters we can define anywhere from 1 to 128 bytes of digital data to be intercepted, decoded and used by our internal circuitry as we deem necessary. Correct?
TLM is the serial output from your experiment to the Carrier. CMD is serial input to your experiment. And yes, the experimenter defines the length and content of each command sequence.

Other than the defined power inputs, there are no other provisions for inputting analog signals to the experiments. Correct?
Yes

The analog signals (telemetry) are converted to files which we obtain from the internet. Correct?
The telemetry will be put into files along with other data like Time Tags. The means by which you will obtain these files is not completely defined but will most likely be via email or ftp.

I also see two sets of differential CMD pins and 1 digital CMD pin. I assume these are the input commands we are responsible for defining (request to send via the internet). And I assume their use is similar to the differential and digital TLM pins. Correct?
See 6.2

September 17, 2003
How do I obtain a copy of SEARS if I am a foreign national?
Please contact John Kazeva, john.kazeva@gsfc.nasa.gov

Other Questions

July 1, 2003
Please provide information about DMSP.
Here are some web links to GOES, POES and DMSP spacecraft. DMSP satellite is similar to the POES spacecraft. These are all weather satellites.

http://poes.gsfc.nasa.gov/
http://dmsp.ngdc.noaa.gov/dmsp.html
http://www.gsfc.nasa.gov/topstory/20000330tiros_anniversary.html

July 2, 2003, Updated November 4, 2003

Do we know what the expected total dose will be on SET-1?What is the expected rate of exposure?

What is the dominant source of radiation, is it protons?

Jim Howard is working the environment study for DMSP SET-1 option under Greg Martins. I do not know what the schedule is for delivery of environment study, but suspect mid-November.

That said, the DMSP is ~ 848km sun-synch (i.e., polar). It gets decent proton dose exposure from the SAA and potentially from solar events (over the poles). I'd expect about a 90 degree or so unobstructed space view access with only the cover between that exposure and free space (we've got s/c , solar array, and our own enclosures/structure to deal with in the other 270 degrees).

If you assume that the spacecraft side is basically killing >1/2 the exposure, and the box cover is ~ 10 mils, you'll get plenty of dose a year. There is some shadowing from the solar array so the more detailed 3-d ray trace will take some time...

What you should do is give us a spec of what you need for dose/orbit (average) or dose/year at DUT and we'll work to get that level. Two numbers: desired level and minimum level of exposure (I.e. we'd like 200 krads/year, but can live with 75 krads...) Ken LaBel

August 27, 2003

How can I found out more about ITAR? (6/5/03)

The web address for ITAR information is: http://export.gsfc.nasa.gov

What are the parameters (Apogee, Perigee, Inclination, etc.) of the first three orbits that will be available to SET? I will use these parameters to generate the radiation data for the work in tasks LE1 - LE3. This will also help make a decision for which flight is best. (6/19/03)

I currently have information for the proposed SET-1 mission on the DMSP-18 spacecraft. DMSP-18 can be selected for one of several Solar Orbit Angles (SOA) and I'm not sure when we will know when that is determined. Upon request we will send out the LWS-SET1 DMSP Thermal Model – Orbits.ppt (located in VSDE). It is a Power Point slide which summarizes the DMSP-18 orbit information best known at this time. (6/22/03)

What are the mechanical dimensions of the RCA? 6/25/03

In VSDE are two drawings in .dxf and .dwg format. The drawing titled lid envelope with box shows the dimensions of the SET electronics box and the mounting planes for lid and board experiments. The box will be fabricated from 6061-T6 aluminum and your lid/board experiment would be mounted in slot #1 or #2. Slight modifications to this box are in process but I think that they will have very little effect on what your trying to do now. The other drawing called lid envelope shows you the mounting pattern and proposed envelope for lid-mounted experiments. Don Jarosz 6/27/03

July 18, 2003

Some experiment may not need to be sampled every second as is the plan. They may only require infrequent sampling of only a few samples per orbit. Is an experiment required to be included in this scan (perhaps with a 'heart beat'), or are these simply reserved slots?

Yes, they are reserved slots and a heartbeat response on some frequent basis (TBD) is desired. Also, a slot can be skipped.

RADFETs may require seconds of bias before a sample is taken. How does this relate to

the 1 second scan mentioned above. Would we be required to support a "bias" command issued at scan 'n' and a second "sample" command to be issued at 'n+15' for a 15 second bias-to-sample time (for example)?
Power/bias provided continuously and not related to 1 second scan. Refer to 2nd paragraph of Section 7.1.

What is the required response time between "send serial command #1" and "store telemetry #1"? If this time is short, is there a mechanism to respond from the experiment with "Not ready" allowing the telemetry to be picked-up on the next scan?
Yes, i.e. in some instances a "telemetry response is required" but must the response doesn't need to be the
final response to the command.

The response to a command must be in the same time slot, but the experimenter decides the definition of what the command does, what the telemetry response is, and in what time slot the particular commands and responses occur. Commands can be scheduled based on time tags or can be triggered based on the response of a previous command (i.e. and event). So examples of what you're asking could be:

Time Slot 1 - CMD (Start Sample), RESP (Sampling Started.)
Time Slot M - CMD (Send Status), RESP (No Telemetry Ready)
Time Slot N – CMD (Send Status), RESP (Tel Value#1, Tel Value#2, etc.)

Or

Time Slot 1 - CMD (Start Sample), RESP (Sampling Started.)
Time Slot N –CMD (Send Telemetry), RESP (Tel Value#1, Tel Value#2, etc.)

Are the "SET normal mode" and "SET standby mode" commands via the RS422 link, or are these discrete control signals?
Discrete CMOS signals, refer to Section 6.2.1.2. They can also be decoded commands via RS-422.

Can the processor in the SET Carrier provide all time values for this experiment (or can they be extrapolated at the SOCC)? The times we need are "biased" and "unbiased" times on the experiment for extrapolating RADFET exposure curves. (i.e. we're verifying that this experiment has no need to maintain any time values, as continuous power is not guaranteed.)
The plan is for the time to be extrapolated

Can the decoded reset option be used reliably to indicate the 2ndary power is stable? (i.e. can experiment logic be released from reset simply based on this signal, or will local (experiment) voltage comparison be required on the power rails).
Yes for reset option to be reliable to indicate 2ndary power stability.

Can the backplane clock be relied upon in all normal operation modes - allowing possible elimination of all local experiment oscillators?
Yes to backplane clock possible elimination of exp. Oscillators.

July 22, 2003

Rx related issues:
We need to know if we will see other command traffic on our dedicated RS-422 command line. The specification is not clear in this area. It appears that we have a dedicated command line, yet it also defines an addressing scheme for the individual experiments. If the line were truly dedicated, we would not need to sort commands based on an address.

It may be that we have a dedicated hardware link, but the S/C broadcasts commands to all experiments simultaneously thus the need for the addressing. In this case the receiver will need to receive the full command including address information, control byte, start and stop codons, and checksums. This would be far more complicated than a simple high to low edge detector on the command line.

Tx related issues:
There is a similar complexity issue. We would like to simply add start and stop bits to the current data structure and transmit that sequence a fixed delay after receiving the transmit/enable command on the Rx line. However, the specification outlines a start/stop codon, control byte, address bytes, and CRC checksums. Also, according to the current specification, certain bytes will need to be detected and replaced with a substitute pattern before transmission. Again, this is much more complicated than simply adding start and stop bits to the current data structure.

It is a point-to-point interface. The RS-422 specification is a point-to-point physical specification. The addressing scheme is only called out for experiments using the HDLC classes. If you plan on using the "Experiment Defined Class" called out in 6.2.2.4 of the SEARS document, then no address is required.

July 21, 2003 Telemetry and Analog Signals

The 4 output signals are TEMP P&N (pins 18-19), DOS P&N (pins 45-46), and ANA1 P&N (pins 72-73) and ANA2 P&N (pins 20 and 47). TLM N422A/P422A (pins 41-42) and TLM N422B/P422B (pins 67-68) are DIGITAL INPUT signals in differential mode. Is this interpretation correct?
Half Correct. Section SEARS 6.1 Describes the Analog telemetry of Temperature, Dosimeter, Analog 1 and Analog 2. Section SEARS 6.2 describes Command and Telemetry interfaces. Note, the pin-out contains an “A”, primary, and “B”, redundant 422 differential interface pair of both Command and Telemetry. The “B”, redundant pair is not implemented and is in the pin-out for future use. Also note, TLM is an OUTPUT from the Experiment. CMD is an INPUT to the experiment.

What is TLM (digital, pin 53) intended to be used for?
See section SEARS 6.2.1.3.

Assuming the Telemetry TLM pins are input pins, as experimenters we can define anywhere from 1 to 128 bytes of digital data to be intercepted, decoded and used by our internal circuitry as we deem necessary. Correct?
TLM is the serial output from your experiment to the Carrier. CMD is serial input to your experiment. And yes, the experimenter defines the length and content of each command sequence.

Other than the defined power inputs, there are no other provisions for inputting analog signals to the experiments. Correct?
Yes

The analog signals (telemetry) are converted to files which we obtain from the internet. Correct?
The telemetry will be put into files along with other data like Time Tags. The means by which you will obtain these files is not completely defined but will most likely be via email or ftp.

I also see two sets of differential CMD pins and 1 digital CMD pin. I assume these are the input commands we are responsible for defining (request to send via the internet). And I assume their use is similar to the differential and digital TLM pins. Correct?

See SEARS 6.2

If a transistor selection scheme that uses mechanical switches which we would set/reset based upon the telemetry input frames we define is used, are there any ideas/suggestions as to specific switch types/mgr we should be looking at? We can check with our parts engineer.

August 21, 2003 Questions from NSREC

Can the Carrier handle 24 command sequences?
Yes

How many commands can be sent for each DUT?
Multiple commands and their responses must still fit in 40 msec window.

Will the Carrier be capable of tagging each analog data signal with which DUT it is from, if there is a unique command sequence for each DUT?
Yes.

How long can each command sequence last?
A sequence and its telemetry response must occur within a 40 millisecond window.

Is there an analog input?
No.

How critical is the 80/20 split for +/- voltages? Can the split be different, i.e. all of one and none of the other? Is it just to maintain regulation?

The 80/20 current ratio is a specified requirement on the +/-15V, +/-5V DC to DC converters and is required for correct regulation. This is an assembly/box level requirement that we meet by requiring every experiment to draw 80%/20%. If an experiment wants just one voltage from the supply, we could look at balancing the load on the carrier side. However, this will reduce the experimenters overall power limits. For example, if they want just +15V, they would be limited to 3.2W (.8 x 4W). We have to account for the 20% power somewhere. Of course, the experimenter can always ask for a waiver, and if we have the spare power, we could provide it.

Can an experiment get up to 8 Watts on a 6U board?
This is difficult to answer because it is something that needs to be negotiated with the project. So let me just provide the technical description of the interface.

a. Section 2.2 of the SEARS document that all services provided are per card interface port. The 6U card has two ports, so 4Watts could be drawn from each port for a total of 8 Watts. In fact, each voltage service in each port is capable of 4 Watts.

b. The real issue that has to be worked out after the complement of experimenters is known is to determine the box/assembly level power budget. Each converter has a 7.5 Watt limit. We obviously can t fly 4 experiments drawing 4W each from just 3.3V for example. That would be 16Watts of 3.3V and no power drawn from the +5V, +/-15V, or +/-5V converters (not including carrier power).

c. The drawing of 8 Watts can't even be done non-continuously. Again, the box/level power budget (including duty cycling) needs to be worked.

d. Whatever the power cycling turns out to be, it is controlled in the 40mS communications window. This doesn't mean the experiment is only powered in the window. It is just commanded to on/off/standby during the window and maintains that state until commanded differently during the same or following window.

What is the Carrier Simulator delivery date he can plan to?
Updated November 4, 2003. Version 1 of the Carrier Simulator will be ready on December 1, 2003.

July 25, 2003 Electronics Requirement

For initial testing of the our experiment I'm proposing a simple test board that would provide the 16MHz clock, reset, and standby signals, as well RS232-to-RS422 conversion for connection to a PC (essentially a simple carrier assembly simulator). A visual basic or other simple program running on the PC can then exercise the command/telemetry interface.
We will be creating a carrier simulator that simulates the RS422 interface. It will consist of an RS422 card or RS232to422 converter and an accompanying software executable. The exact form has not been completely defined. The clock, reset, and standby signals were not going to be part of this simulator, but we may look into adding them. I cannot give you a good date on the availability yet.

You may be interested in some serial port PC cards made by National instruments that plug into your PC that give you added serial ports but with RS422/485 signaling. PCI-485/8 and PCMCIA-485/2 are two of the models we have in our lab.

July 29, 2003 Parts

I want to use a Teledyne relay on my experiment. Is this part OK with NASA? If not, is there a similar part that is OK and what's the part number? I'm looking for small, low power (this one has the transistor built into the package so it can be driven from the logic) and hopefully lightweight as I'm forced to use several in this design.
After reviewing the enclosed Teledyne data sheet, it appears to be equivalent to the mil spec part M39016/15-077M through M39016/15-081M. The military part would be the preferred part (listed in GSFC PPL21, Grade 2). Note: this Mil spec only contains an internal diode - no transistor. Teledyne's data sheet states "Hi-Rel" available. I've written to Teledyne and asked if they can screen and test in accordance with MIL-PRF-39016 requirements (this would be preferred). Will advise when I get a response back from Teledyne.

August 1. 2003, Updated November 4, 2003 Requirements Contact

Who can I contact with questions about satisfying requirements for the mission?
Please contact the Experiment Manager, Carolyn Mariano, 301-286-8020 and/or the Mission Assurance Representatives Mike Kelly, SET QA, 301-286-0662 or Terry James, SET Systems Assurance Manager, 301-286-0745.

July 31, 2003 Radiation and Temperature

I have a question about the effects of temperature on the voltages of the fets in an ESAPMOS-04 (RADFET.) An attached file is a summary of measurements made for the number three fet (one of the 300/50) in a RADFET. I would appreciate your thoughts in response. If content of the attachment is not clear or sufficient to provide an understanding of what I did or my concern then let me know.
I guess I don't see much of an issue here. According to the table, the only time the temperature variation may be significant is for very low doses where we won't really care about. By the time we get to 10 krads, the maximum error induced by temperature variation will be about 2%. The dosimeter itself is not good to that level of resolution. If we do have a concern about the lower doses, every dosimeter being launched will have a local thermister recording the temperature. I believe with this data for all the dosimeters flying, we would be able to "correct" out any temperature effects (but right now I'm not sure that would be worth the effort).

The Parts Branch is reviewing this concern. Will advise if further information becomes available.

October 17, 2003

Regarding NRA 02-OSS-04 Appendix B Figures B.3.6-1 through -3
Fig B.3.6-2 Phase B is when the downselect has occurred and you have been selected for the next funding phase. Real Year dollars are total money spent adjusted for inflation 3.1% for a Fiscal Year Oct-Sept. Phase B begins when you have been selected so that would be around Feb 20, 2004. Phase B would be the implementation phase where you would finalize your design and development/build things to prove your concept like breadboards. Phase B would be the implementation phase where you would finalize your design and development/build things to prove your concept like breadboards, fabrication of ETUs and test and evaluation of ETU(Design and Development). Phase C/D begins when you begin building flight hardware, do test and evaluation, delivery, launch and checkout.Multiply all the costs by the cumulative inflation rate to get the Real Year dollars. 2004 -1.031, 2005 - 1.063, etc.

Fig B.3.6-3 I would say this is a sample of the type of information they would like to see based on your own WBS. The WBS presented in Fig B.3.6-1 is just an example and may not be the way you created your WBS. Then Fig 1 is transferred to Fig 3 as an example but if your WBS is not the same as their then you may set up Fig 3 differently. Your costs may go under different categories. Some direct labor costs would go into Management and some may not. You may have Flight Hardware separated from Ground Hardware so your costs would be broken down as such.

Experimenter Schedule
I received a request for a schedule for experimenters and I have already been working on it. I will get the schedule as soon as I can. When I sent out the email regarding Risk Management, I was just taking a poll to see if anyone had addressed it. It is a section in App B so I assume it will be addressed in the final study report. Risk Management is something a) people don't always think about; b) may think about it but don't write it down or plan; c) may be on a path for failure when they don't do it. We want to make sure everyone is successful.

October 27, 2003

No Power Monitoring
Current going to each voltage being provided to experiments is not being monitored by the carrier. If an experiment needs it, they could provide measurement circuit on their side and provide it back to the analog channels.

Is there a chipset available for the RS422 interface that they should be looking at?
Should look in section 6.2.2 for three protocols that can be followed. Two are HDLC classes; one is experiment defined. HDLC classes intended for experiment with variable length data. If data not variable, can use experiment defined class. 6.2.2.4 includes the specs for experiment defined one. Some highlights:
1) You can use HDLC but not use all the features (i.e., you can decide not to use CRC check).
2) if frames are deterministic, then you may not need to use HDLC class at all.
SET is programmable to handle different baud rates on our side; if experiment needs a waiver for baud rate this will be considered. Experiment needs to provide baud rate, frame format, byte format, and frame format of response.

What is the standby pin out configuration?
If high, it is in standby, if low, it is in normal.

Are there requirements on external finish on the box? Updated November 5, 2003
Yes. Must meet NASA outgassing requirements. For SET-1, if you are using white paint, you are limited on what can be used.

What are nominal operational temperatures?
-15 to +55 deg C. Heater control will maintain lower end above -15 deg C.

What will the carrier be using for triggers?
It will be based upon capabilities of instrument. We will need to interpret the CEM data and spur actions in other experiments.

Tin and Whisker Generation
Do whiskers grow or may generate from materials containing tin, such as solders, pewter, etc?

Tin whiskers usually originate from pure tin coatings or platings that have residual stresses incorporated within. On the other hand, there is usually no problem of whisker formation from tin alloys such as the usual tin/lead solders. I would like to take this opportunity to mention that only rosin flux should be used with the solder and not any aggressive acid fluxes. FYI: zinc also causes the growth of whiskers and should be avoided.

Silver-filled Epoxy Adhesives
What are the silver-filled epoxy adhesives that are approved by NASA for space flight?

Our recommendations for a conductive epoxy are: Eccobond 56C/cat 9 or Eccobond 57C A/B or with cat 9. There are many other products out there but most of the other products require an elevated temperature (some rather high) cure. The Eccobond products may be used with only a room temperature cure or with some nominally elevated temperature cure.

What is the Parts Program?
The Parts Program describes how your parts selection criteria ensures mission success, [how each experimenter will meet their stated success objectives]. A typical Parts Program discusses responsibilities of a "Parts Control Board", details "Parts Screening and Qualification" criteria, states the requirement for "GIDEP Alert" reviews and dispositions. In the MAR, on page 14, Code 300 inserted portions of my SET Carrier Parts Program. It can be used as a guide by SET Experimenters.

When these requirements are established, a parts list is developed using their Parts Program criteria. GSFC will review the Experimenter's Parts Program for concurrence that their Parts requirements will most likely lead to mission success. After which, GSFC will review the Parts List to ensure it complies with their Parts Program.

In short, the "Parts Program" is documenting the experimenter's parts requirements. It is the vehicle by which the Parts List is reviewed.

October 23, 2003
Do you have a list of NASA approved rad hard parts? This would expedite our process for selecting the correct components for our circuit.
No, there is no longer a current composite parts list, especially listing rad hard parts. However, the DSCC web site has search capability where you can restrict the search to rad hard parts, and has search categories of devices by description or generic number. This is quite helpful - [hint: remember part number codes for total dose are: "D" = 10krads; "P" = 30krads; "L" = 50krads; "R" = 100krads; "F" = 300krads; "G" = 500krads; and "H" = 1Mrads. Number would be listed as "5962RXXXXXXXX for 100krads parts.]. The DSCC Microcircuit Cross Reference web link is:
http://www.dscc.dla.mil/Programs/Smcr/

Another useful web site is GSFC's radiation effects site. They also have a searchable database - a broad search can be performed by part type (insert device function in "category" section). Their web link is:

http://radhome.gsfc.nasa.gov/top.htm

Other reference materials/sites would be:
http://nepp.nasa.gov/index_nasa.cfm/874/
http://www.nepp.nasa.gov/npsl/mic/mono/NSL_SUM.html
http://nepp.nasa.gov/DocUploads/AA0D50FD-18BE-48EF-ABA2E1C4EFF2395F/ppl21notice1.pdf (old GSFC PPL)
http://progate.daps.dla.mil/home/ [can look up MIL-STD-975 on this site]

Do you know of a vendor that sells a rad hard UART to add/delete the start and stop bits on the serial data stream? I have checked several vendors for this without much luck.

This is a much harder question to answer. I'm still researching this issue; however, the only rad hard possibility I found so far was an ACTEL UART Core that can be can be programmed into one of Actel's rad-hard products. The following Actel web site lists the various UART cores they offer: http://center.atomz.com/search/?sp-q=uart&sp-a=sp10024442&sp-p=any&sp-f=ISO-8859-1

I'm still looking for a monolithic UART that's rad hard, will let you know if I find anything. By the way, are you using a microcontroller or microprocessor that has UART functions? I've seen a number of these devices - but it's not what you asked for.

In MAR, says they need PIND tests on devices. What is requirement?
The experiment MAR requires a Parts Plan from each experimenter. They will determine what parts testing is required to ensure their experiment will meet their objectives and mission success. The MAR has the SET Carrier Parts Plan attached as a guideline. It is highly recommended that cavity devices (without getter material) have PIND testing since this will determine if there are any loose particles in the cavity. In zero-g environments, these loose particles can shift and short out devices. This issue would have to be addressed in the Parts Plan if experimenters opt not to perform PIND.

Is it essential to have the dosimeter from SET in the experiment?
If an experimenter wishes to use an alternate GFE part; (i.e., RADFET), they need to submit a specification/datasheet for the device they wish to use. GSFC will review the alternate part to determine if it will effectively interface with the SET carrier. However, if an experimenter wishes to eliminate the function performed by the GFE device, (i.e., remove RADFET and not supply dosimeter readings), a waiver and approval from SET Project would be required.

How is SET biasing their radfets?
SET Project Office will supply RADFET biasing scheme once it is completed.

When are mechanical stress and thermal model analyses due?
Need this about 30 days prior to the CDR.

Does GSFC need a mass simulator from the experiments?
Don says no, if one is needed we can develop it here based on mass and c.g. info.

Are there concerns about a lot of people not meeting the 250 gram limit?
Generally looks like this limit will not be met by many. Limit has not been raised at this time. Need to know in a timely manner because otherwise experiments may begin to skimp on design to minimize mass.

The following web site is a composite list of various specifications (both military and GSFC) that's recommended for use on Space programs.
http://nepp.nasa.gov/index_nasa.cfm/619/?id=029B9C4E-CACC-436D-815C9461915E7009

Can we sample analog line whenever we want to do they need to tell us to keep sampling?

Once the preset timer is started, the carrier will keep sampling for the duration of the measurement.

What is the expected thermal fluctuation?
Not modeled yet in detail, but should be within order of 15 deg C throughout orbit.

Is it okay to use voltage doubling?
Systems Safety pointed out that doubled voltage will need to be addressed in the safety package. Later in the project a safety checklist will be sent out for completion and submission.

Are there any radhard UARTS?
Only one Parts Engineer knows of is one that can be embedded in an FPGA. The Parts Engineer is researching it.

Does SET have rad hard counters?
The Parts Engineer will have to check her stock.

Does SET require an outgassing test?
No, we require the individual components meet outgassing criteria previously defined.

Can parts be put on both sides of board?
Yes, as long as they fit within envelope. Probably want to put most sensitive parts to radiation on the bottom of the board so they are shielded by the board.

Are there any requirements on surface mount or through hole?
Need to make sure boards can pass vibration and guidelines. Flatpacks are no problem. GSFC can provide inspection guidelines for the board if they are needed.

Does an experiment need to do mechanical testing?
Each experiment is expected to do it themselves.

If power is lost to carrier, will all signals go low?
Yes.

Interpretation of 6.2.2.2.7 is that if they are using the experiment defined protocol, they do not need to define the unnumbered information and test command. Is this correct?
Yes. Need to have information, address and control fields even if they contain blank information. Do not need to use HDLC at all if they use this format.

Regarding workmanship standards for surface mount devices (particularly flat pack devices). Section 5.1 of the Experimenter's MAR lists NASA-STD-8739.2, Workmanship Requirements for Surface Mount Technology.

July 22, 2003

What's the primary difference between cmos and RS422 for the SET experiments?
RS422 is based on a differential signal which requires the experimenters to have a differential receiver and driver

Communication protocol between the Carrier and an Experiment; Who initiates the talk and how?
Carrier initiates the communication by sending a serial command to the experiment

Is Carrier to Exp message (commands) link a bus (i.e., message with listener address) or point-to-point (no need of listener address)?
If experimenter utilizes the HDLC data link layer then the link is a bus (requires a response to the command), but if a custom defined format is chosen, then it is point-to-point

According to SEARS, there are 3 data link layer. Can an Experiment choose any one of these?
Yes

Analog Telemetry; Is the sampling autonomous (independent of Experiment board operation)?
Yes

If it is, how often analog telemetry is sampled?
Once per second

And how they are included in the downlink with other data?
In data frame as defined by the format

If the analog telemetry sampling is command based, what is the protocol?
No command is necessary as this is done automatically. However, the experimenter can specify which of the four available channels to be put in this telemetry, refer to section 6.1 in SEARS.

How does this the effect digital telemetry collection?
No effect

Can they be mixed? - is analog sampling considered a part of 40 ms window?
Yes, they can be mixed. It's a separate 40ms window

Or is it considered as one 40 ms window?
Yes.

Are the analog readings available to Exp. board or are they strictly for the Carrier to downlink to the ground?

Yes, they are available via commanding.

Interconnection: SEARS list WG80SAD7SY for the Exp board and WG80PR7SY for the back plane. It looks as if they are switched. Can you confirm it?
Yes, they were switched.

There are two sets of TLM and CMD lines (TLM A, TLM B, CMD A, and CMD B). Can any one of these be used or is there specific lines assigned to different Experiment?
Only TLM A and CMD A are available.

Are commands alpha-numeric (as "SEQ_QUE_TT") or are they op-code based?
TBD, need Appendix C of SEARS

If they are alpha-numeric, what is the minimum/maximum length?
TBD, need Appendix C of SEARS

What is the maximum number of commands allowed per Experiment?
As many as can fit within the 40 ms window

I happened to be scanning through the kickoff slides and saw the last slide in Jim Howard's presentation. His dose is two orders of magnitude less than what I found! One of is wrong (it could be me.) If Jim is correct then use of the radfets may provide me a serious problem and I may not be able to get a good evaluation of my experiment. I am assuming that the design of the RCA had not been completed at the time of Jim's

presentation. So, what was he modeling? Was this an Equivalent Aluminum Spherical Model?
The only data I presented in the kick-off meeting was a dose/depth curve assuming a solid spherical Aluminum shield. No attempt was made at that point to look at the 3D shielding or actual RCA thickness. The mechanical folks here are increasing the wall thickness of the RCA boxes to 200 mils (so the carrier electronics will survive a worst case orbit (which is not the SET-1 mission)). So you will have a significant amount of side shielding if you are inside the RCA enclosure, only the solid angle outward facing will be low shielding thickness. So the more dose you want the higher you should place your devices in the RCA enclosure, or atop the enclosure, if you really want dose.

What PCB thickness is assumed for the experiment boards - 0.062"? I'm not sure what thicknesses the backplane connector can support.
Minimum thickness - A minimum thickness of .062" is recommended for structural integrity. However, the board will have to be modeled and also pass vibration testing to guarantee this.

Maximum thickness - The connector leads are .109" in length. GSFC-NASA recommends .020" minimum of lead extension out of the opposite side of the PCB. So that equates to a maximum board thickness of .089".

Board Mounting - The board mounting surface is on the same side as the connector. So changes in board thickness do not move the connector position with respect to the backplane connector.

In SEARS 6.2.2.2.2, its not clear to me how a single flag can be used for both a start and stop delimiter unless the receiver expects this a-priori. Is there something in the command field that would indicate multiple frames linked in this way? Can an experiment op-out of this? In a hardware implementation this would add complication the state machine design.
This may not be as complicated as you think. Here are a couple of thoughts that may clarify this.

As an example, in our state machine for the receive section, at the reception of a frame flag, the state machine is set to the start state. The next byte expected is the Address field. If we receive another frame flag, we just loop back to the same start state. We have a timeout condition that resets the state machine if no more bytes/frames are received. After power up or a reset(manual or timeout), the state machine defaults to a reset state where the first frame will require a frame flag at the start.

Specific to the next higher layer protocol, Layer 2, Section 6.2.3.2 specifies that only one command will be sent per frame and that each command requires a response. So the Carrier will not be sending the experiment any multi-frame commands. However, the Carrier is capable of receiving them from experiments.

Also, as the experimenter, you define all of the commands and responses. So even if we did allow multi-frame commands, you still have the choice of not implementing any.

Finally, if you would like to customize this protocol, you can use the Experiment Defined Class, 6.2.2.4, that allows you to use the built in features of the HDLC classes or just have fixed length commands and responses. You would have to specify the details and work within the capabilities of the interface, but the intent is to implement the simplest interface required by the experiment.

In SEARS 6.2.2.1 how are the baud rates set? Is this commanded via the interface, externally jumpered, distributed baud clock ...? If commanded, will GSFC be providing the encoding for these commands? What speeds are required to be supported beyond the 48K, 64K, and 128K, mentioned?
On the Carrier Side, baud rate is set with a Carrier command.

For the experimenter, the baud rate will not change during operation. We do specify that the 48K

in the nominal with a maximum 64K. Since we do not specify how to set this, jumper settings could be one possible implementation. The choice is yours.

The 128K is just specified for information purposed only to indicate the Carriers maximum capability. It is also capable of rates much slower than the 48K nominal.

If you would like to operate at one fixed rate that is not configurable, faster or slower than the nominal or maximum, you can always try requesting a waiver from the project. If you do this, I suggest sticking to a standard frequency that can be simulated with a PC serial interface.

Under what circumstance is STANDBY mode used? Slide 59 of Kickoff #2 implies experiment is put in STANDBY after every 40mS communications window. The implication seems to be an experiment must draw <100mW except during its comm. window or power will be removed completely between comm. windows - correct?
Not Correct. Section 7.1 of the SEARS document indicates that communication is limited to the 40ms window but that power is applied at 100% duty cycle. Typically, an experiment will be commanded to standby mode or normal mode during the 40mS communication window and will remain in the last mode commanded at the end of the window until commanded again in a following communications window.

Standby mode is mainly for two purposes. 1st, to share power resources among experiments while allowing them to maintain biases on DUTs or volatile memory. 2nd, it may be used as a safety mechanism to minimize experiment power draw during anomalous conditions.

Slide 59 was just an example of an experimenter needing normal mode power to communicate, and only needing bias power other times. When I wrote the example, I was thinking of a simple RADFET experiment that needed a small bias current on the RADFET, that could then power up to normal mode to take a measurement and send out the value as telemetry, and then go back to just the bias condition again.

Is tri-state control required on the RS-422 transmitter? The wiring diagram implies point-to-point connection between experiments and carriers. If point-to-point, is there anytime the TX should be tri-stated ... e.g. STANDBY?
Tri-state control in not required. RS-422 is a point to point or multi-drop(one to many) specification that only allows one driver(generator) per line. RS-485 is the similar specification that uses the same drivers and receivers as 422, but allows for multipoint (multi driver, tri-state capable) connections. We specify RS-422 only.

As an added note, there have been several questions about the address field requirements in the HDLC formats. Part of the reason for using the address field is to maintain compatibility with the HDLC specification and additionally to allow for the possibility of automated command and telemetry routing to different paths of the communications channel. As stated before, the experimenter can modify the HDLC standards using the Experimenter Defined Class for the Layer 1 protocol. You could either not have an address field or have a dummy value in this byte. It cannot however be used as an extra telemetry byte over the 128byte maximum.

<u>Carrier Simulator</u>
Also, a few thoughts occurred to me while working on the electronics requirements for the experiment. For initial testing of our experiment I'm proposing a simple test board that would provide the 16MHz clock, reset, and standby signals, as well RS232-to-RS422 conversion for connection to a PC (essentially a simple carrier assembly simulator). A visual basic or other simple program running on the PC can then exercise the command/telemetry interface.
We will be creating a carrier simulator that simulates the RS422 interface. It will consist of an RS422 card or RS232to422 converter and an accompanying software executable. The clock,

reset, and standby signals were not going to be part of this simulator, but we may look into adding them.

You may be interested in some serial port PC cards made by National instruments that plug into your PC that give you added serial ports but with RS422/485 signaling. PCI-485/8 and PCMCIA-485/2 are two of the models we have in our lab.

NRA Appendix B Questions – November 2003

The NRA appendix B only lists required appendices for the Phase A Study Report. We believe it would be useful for reviewers if we submit our design report as an appendix. The full design document, with algorithms, schematics, timing diagrams, etc. show much more detailed information than can be covered under the 25-page limit of the core of the Phase A Study Report. Are we allowed to submit this as an additional appendix?

The short answer is yes. Contractually, you can include in the appendices anything you would like. You are on the hook to submit to us what we asked for but if you would like to submit extra stuff because you think it is good, than go ahead. We may not get to it and we may not consider it. Just make sure you include in the main report what we ask for and don't assume we will look in the design report for the answers. It sounds like it may be more detail than what we are looking for in the report. This report is basically supposed to reflect your management plan of the experiment, whether it sounds like you can get good science, engineering-wise if you sound like you can create a good experiment, stay within costs and stay on schedule.

Do letters of support (in appendix) get sent to NASA directly? If so, to what address? Or do we send them in with proposal?

Letters of support/endorsement/commitment get sent to you and are attached to the Report in the appendices.

When exactly are the Phase A Study Reports due?

The contracts were let for 6 months. June 2, 2003 through December 1, 2003. The reports, an original signed document and ten copies are due to Julie Janus at the address listed in App B by COB December 1, 2003. Some have ask if they may email an electronic copy of their report. Yes, you may if you wish, but the electronic copy is in addition to the original and ten copies.

What is required to be stated in the letters of endorsement other than our collaborators agree to participate? Must the details of participation be given?

The letters of commitment/endorsement/support I have seen state that the organization is going to support and doesn't say how. The letter can say how if you want to but we are just looking for in writing that an organization will commit. Maybe if there are several it can list how it will support i.e. electrical or mechanical engineering.

Page 3 of App B What are the categories of SET?

It is not either box or board! The categories of SET as listed in App A A.5.3 of the NRA are Induced Environment (Environment Measurements), Degradation and Shielding Properties of Materials (Materials), Detectors and Sensors Performance (Detectors and Sensors), Performance Characterization for Microelectronics (Microelectronics), and Charging and Discharging Effects on Spacecraft and Spacecraft Components (Spacecraft Charging).

Please clarify when Phase B, and C/D occur.

Phase B begins when you have been selected so that would be around Feb 20, 2004. Phase B would be the implementation phase where you would finalize your design and development/build things to prove your concept like breadboards, fabrication of ETUs and test and evaluation of ETU (Design and Development). Phase C/D begins when you begin building flight hardware, do test and evaluation, delivery, launch and checkout.

Do I need to send an electronic version of the Study Report?

It is not required. You may send it to me Carolyn.Mariano@nasa.gov if you would like. It may come in handy and easier for archiving in this electronic age. I don't plan to distribute it, since it may be competition sensitive.

Parts Questions - Novemer 2003

What is the grounding scheme for the system? 5.7.5 in SEARS states that there is a recommendation on how to generate chassis ground reference and still maintain impedance requirements. What does this mean?

The zero point reference (ZPR) is the grounding point where we tie our A to D converter and is also the single point ground for all of the DC/DC converters for each supplied voltage. It is provided as a quiet reference point that is free of noise or DC current that the experiment may be producing on the supply returns. To keep it free of noise, minimum impedance is required for experiments interfacing to it. If the experiment chooses to reference this, how they do this and meet the impedance requirement is up to them. Section 5.7.5 of SEARS is not to suggest the actual details of implementation, but just that they should buffer the ZPR to avoid drawing current".

What is the difference between "V" and "Q" level parts. Which are preferred for SET?

Class "V" and "Q" are the QML levels specified in MIL-PRF-38535 for monolithic microcircuits. Class "V" is equivalent to Class "S" and are required on Grade 1 Programs. Class "Q" is equivalent to the old MIL-STD-883, Class "B" devices. They are acceptable for use on Grade 2 and 3 Programs. (SET is a Grade 3 Program). Class "V"/"S" devices have additional data and screening requirements, including Particle Impact Noise Detection [PIND]. It is recommended that all cavity devices (without getter material) have PIND testing, which can be done by either the manufacturer or an outside test lab. NOTE 1: PIND is performed to determine if there are any loose particles which could short the device in zero gravity. If PIND is not included in an experiment's Parts Plan, I would recommend that a statement be included as to how your mission objective will be met if microcircuits were to short. Note 2: Most hermetic, ceramic microcircuits are cavity devices. Most do not have getter material. If in doubt, ask the manufacturers.

Even though Class "V" devices are more expensive, sometimes the overall cost is cheaper than buying Class "Q" and adding approximately $500.00 - $800.00 per lot for PIND testing. However, Class "V" procurements may have higher minimum buy quantities that would negate any savings. This is a case-by-case judgement call.

What type of packaging does NASA/GSFC recommend for custom devices?

Any of the standard JEDEC hermetic packages would be preferred. If you use LCC packages, verify PWB material is compatible.

Can packaging houses work with JEDEC hermetic packages and back fill with getter material?

Most packaging houses are accustomed to mounting die into JEDEC hermetic packages. The larger ones have used getter material. If they don't, PIND testing can test for loose particles.

What type of testing is needed?

Would prefer MIL-PRF-38535, Class "Q" screening plus PIND. If using "getter" material to fill cavity, can omit PIND. SET is a grade 3 Program and MIL-PRF-38535 QCI testing is preferred but not mandatory. As a minimum, I would suggest:

- Group A electrical testing over temperature,
- A review of Group B subtests might be in order so you can determine if devices will pass an equivalent payload I&T testing.
- Group C, (1000 hour life test) is probably excessive for a Grade 3 Project with a one-year mission

- Group D tests should be reviewed and considered (for the same reason as Group B). Obviously, some, like salt spray, aren't necessary.

Where can I get a copy of MIL-PRF-38535?
Go to DSCC web site and click on search. (web site: dscc.dla.mil)

I'll have my Parts Plan ready next week. Should I send it to you for review?
Yes.

What kind of temperatures will they be exposed to?
The operational temperature range is in the SEARS. Thermostats are set to turn heaters ON at –10, off at –5. Operational limit is -15. COTS-2 temperature requirements are –40 to +85.

4.5 x 4.5 is measurement of card – will not fit in 3U. How will this be mounted?
These could be subassemblies on a 6 u card.

What is required for verification of software?
They will need software to run the experiments – are assuming this will be on our processor. It is TBD whether we will be able to provide this or not. If they have simple processing, may be able to incorporate under the current scheme. If they have something elaborate, may be more difficult to handle. We can only handle 1 kbps on a data read.

Will they get time stamped data and ephemeris?
Yes, the ephemeris will be correlated to ground processing time stamp. Will be within 5 seconds accuracy.

Do we have any feelings for intensity of SAA?
Likely to be moderate based upon altitude. Environmental spec will be distributed shortly – still under review by the science team.

What is risk management for experimenters?
Experimenters need to look at potential risks and mitigation factors. In other words, examine your experiment from the viewpoint of what can fail and how would you solve that problem. These are called Risks and the managing of them is risk management. All aspects of the experiment should be examined including success with your science goals, materials acquisition, engineering goals, age of materials, testing considerations, etc.

One of alternatives for doing the PHA for OSL and LET was to use a small circuit board put out by AMTEC. They do not know why board would not be flyable. Would this cause a problem (attaching boards to other boards)?
This question will be posed to the mechanical and parts engineers.